

## REVIEW

# Carotid webs: a review of diagnosis and management strategies in current literature

Ahmad M,<sup>1,2</sup> Tan M,<sup>1,2</sup> Abuarqoub M,<sup>3</sup> Patel K<sup>1</sup>, Siracusa F,<sup>4</sup> Shalhoub J,<sup>1,2</sup> Davies AH<sup>1,2</sup>

1. Section of Vascular Surgery,  
Department of Surgery and  
Cancer, Imperial College  
London, London, UK

2. Imperial Vascular Unit,  
Imperial College Healthcare  
NHS Trust, London, UK

3. Imperial School of Medicine,  
Imperial College London,  
London, UK

4. London Northwest University  
Healthcare NHS Trust,  
London, UK

**Corresponding author:**

Manal Ahmad  
Specialty Registrar and Clinical  
Research Fellow, Section of  
Vascular Surgery, Department  
of Surgery and Cancer,  
Imperial College London,  
4th Floor, North Wing,  
Charing Cross Hospital,  
Fulham Palace Road,  
London W6 8RF, UK  
Email: mahmad1@ic.ac.uk

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**Plain English Summary**

**Why we undertook the work:** Carotid webs are small protrusions on the inside of blood vessels in the neck where clots can form and lead to a stroke. They are a rare cause for strokes in young people and can be difficult to diagnose. We undertook this review to look at the current research on how this is being treated globally.

**What we did:** We evaluated existing evidence in the literature on the diagnosis, management and outcome of carotid webs.

**What we found:** We found a mix of low- and medium-quality evidence, which suggests there is no clear guideline on the best way to manage carotid webs at present. Options include treating with medication which thins the blood, keyhole surgery to put stents in the blood vessel or open surgery.

**What this means:** There is no clear evidence about which option is better and when this should be done, and further studies are needed. It would be useful to establish a worldwide registry so that data can be standardised and evidence improved.

**Abstract**

**Introduction:** Carotid webs (CaW) are non-atherosclerotic fibrous bands which present as shelf-like linear intraluminal filling defects at the carotid bulb or internal carotid artery. They are a known cause of cryptogenic strokes. Current management includes medical, interventional (stenting) and surgical approaches.

**Aims:** The aim of this review was to systematically evaluate the existing evidence in the literature on the diagnosis, management and outcomes of carotid webs.

**Methods:** This review was performed in accordance with the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A combination of the medical subject headings (MeSH) terms "carotid web", "carotid shelf", "CaW", "web vessels", "Intraluminal web" and "cryptogenic stroke", "ischaemic stroke", "embolic stroke of undetermined source" was utilised in the primary search. Basic descriptive statistical analysis was completed using IBM's Statistical Package for the Social Sciences (SPSS) statistics software, version 29.

**Results:** 123 articles met the criteria and underwent data extraction. This included two registry reviews, 13 cohort studies, 20 case series and 73 case reports. The articles spanned from 1967 to 2024. A pooled total of 771 patients were included (registry and cohort studies n=559; case series/case reports n=212). A higher prevalence of CaW is reported in young female patients and in patients of Afro-Caribbean origin. Symptom recurrence is reduced following intervention in the form of stenting or open surgery in a subset of patients. There is little evidence on the management of asymptomatic CaW.

**Conclusions:** Current literature on CaW lacks homogeneity and is mostly anecdotal in nature. Previous studies have focused on diagnosis, with emerging cohort studies in the last decade evaluating management options. Further large-scale studies are needed. Establishing a worldwide registry will allow standardisation of the data collected and evaluated. Improving the quality of evidence available will help to guide management.

**Key words:** carotid web, carotid artery, cryptogenic stroke, endarterectomy

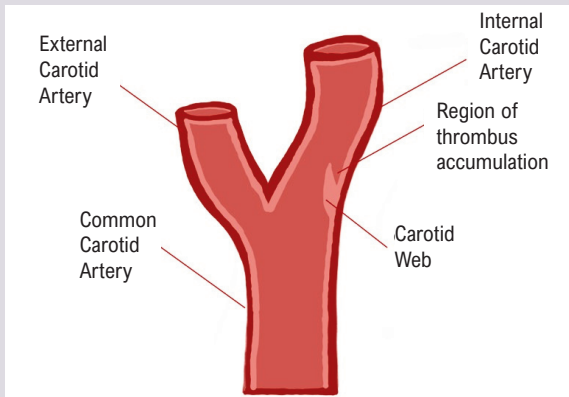
**Introduction**

Carotid Webs (CaW) are non-atherosclerotic fibrous bands which present as shelf-like linear intraluminal filling defects, often on the posterior wall of the carotid bulb or the proximal internal carotid artery, causing turbulent flow (Figures 1-5).<sup>1-4</sup>

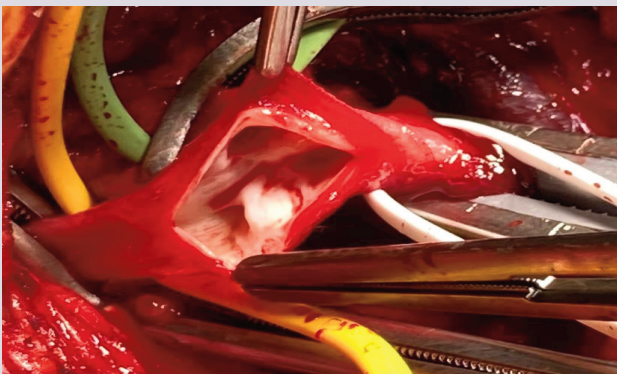
The condition was first described by Ehrenfeld in 1967 and is often referred to as atypical fibromuscular dysplasia due to the fibrosis and hyperplastic changes seen in the intimal layer on

histology.<sup>3,5,6</sup> CaW are difficult to diagnose on imaging and are increasingly being recognised as a source of cryptogenic stroke. The CaW shelf serves as an area for accumulation of thrombus with a risk of subsequent embolisation, resulting in large vessel occlusion and subsequent ischaemic strokes.<sup>7-9</sup> A high index of suspicion should be considered in cases where no other source for the transient ischaemic attack (TIA) or stroke has been identified. CaW are still underdiagnosed due to the imaging challenges and a general lack of awareness of this pathology. Current literature suggests that CaW have a higher prevalence in young individuals (age <60 years), female patients and individuals of African descent.<sup>1,10-15</sup> Current management options may include conservative medical management, carotid artery stenting (CAS) or surgical intervention in the form of carotid endarterectomy (CEA) and web resection with or without patchplasty or segmental resection.<sup>8</sup>

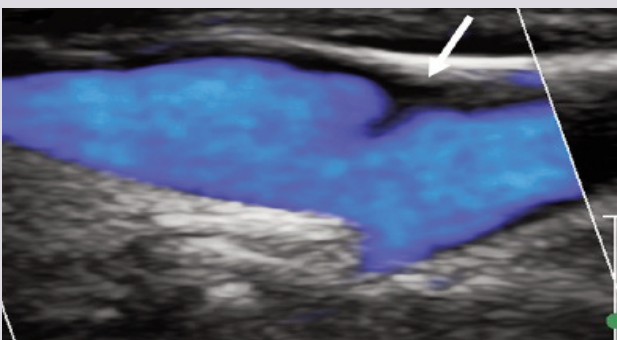
**Figure 1** Carotid Web schematic.



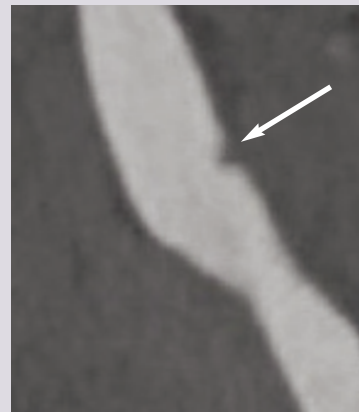
**Figure 2** Intraoperative appearance of a Carotid Web.



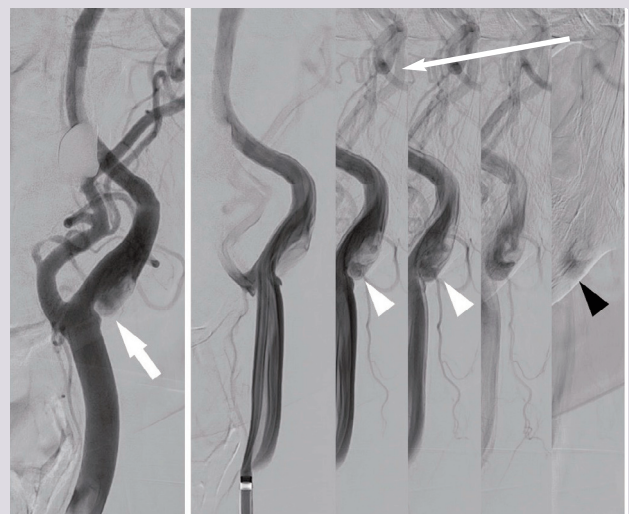
**Figure 3** Carotid Web appearance on duplex ultrasonography.



**Figure 4** Carotid Web on computed tomography.



**Figure 5** Carotid Web on angiography.



## Aim

The aim of this review was to evaluate existing evidence in the literature on the diagnosis, management and outcomes of carotid webs.

## Methods

This review was performed in accordance with the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) statement.<sup>16</sup> The literature was searched using Embase and Medline (via Ovid interface), Web of Science, Scopus and CINAHL databases. A combination of the medical subject headings (MeSH) terms “carotid web”, “carotid shelf”, “CaW”, “web vessels”, “Intraluminal web” and “cryptogenic stroke”, “ischaemic stroke”, “embolic stroke of undetermined source” and “stroke” was utilised in the primary search strategy.

Randomised controlled trials, cohort studies, cross-sectional studies, observational studies, case series and case reports on the subject of CaW were included. Studies were limited to those written in the English language. No time limit was placed for the search and articles up to 2024 were included. The exclusion criteria consisted of studies where only the prevalence or incidence was reported, abstracts, letters and conference papers. The abstract and title screening and full text review was completed using the Covidence software by two reviewers (MAh, KP, MT).

Data extraction was completed by four reviewers (MAh, MT, MAb, FS). The extracted information included the author, year of publication, type of study, number of patients, age, gender, ethnicity, presenting complaint, co-morbidities, initial investigations, investigation findings, territory of stroke/TIA, National Institute of Health Stroke Scale (NIHSS) score, ipsilateral/contralateral disease, acute management, long-term management, histology and outcome. Basic descriptive statistical analysis was completed using IBM’s Statistical Package for the Social Sciences (SPSS) statistics software, version 29.

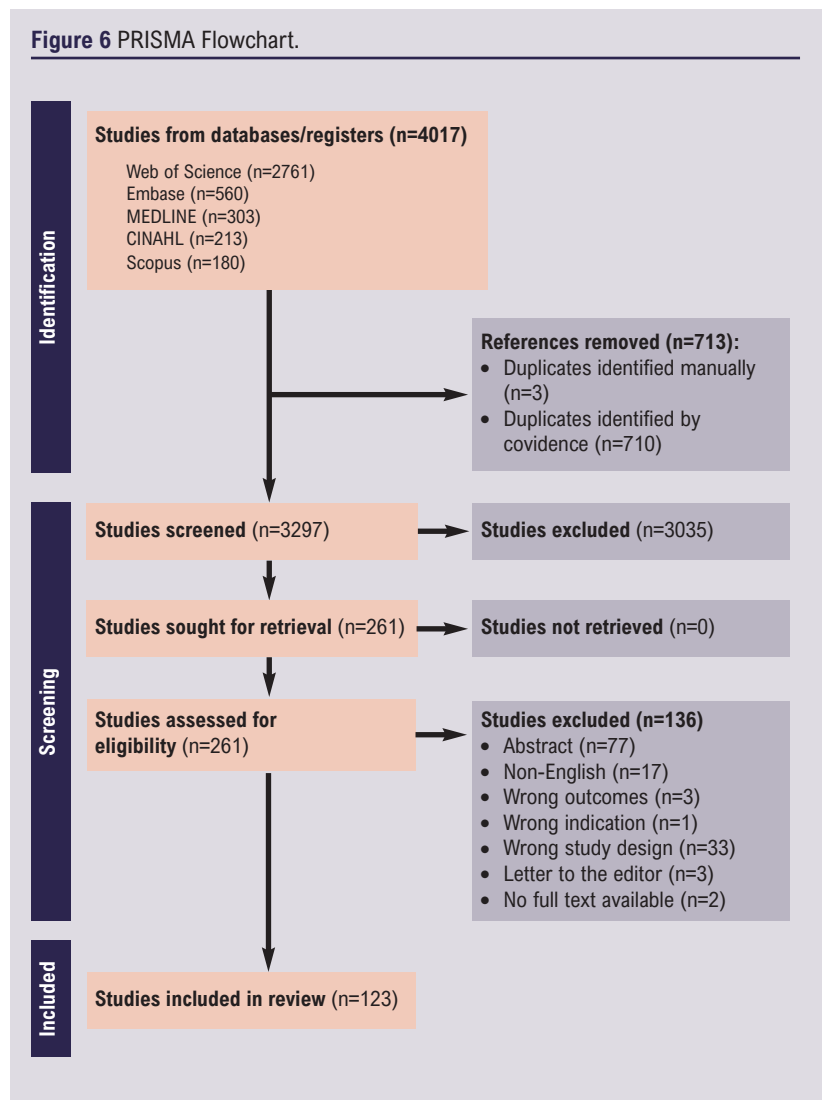
## Results

Some 4,017 articles were initially identified and they are summarised in Figure 6. After de-duplication, 3,297 articles underwent title and abstract screening and of these 3,035 were excluded. 261 articles were assessed for eligibility. 123 articles met the criteria and underwent data extraction. They included two registry reviews, 13 cohort studies, 20 case series and 73 case reports. The articles spanned the period from 1967 to 2024.

A pooled total of 771 patients were included (registry and cohort studies n=559; case series/case reports n=212).<sup>3,6,17-105</sup> The findings are summarised

in Tables 1-4. Further details of each case series and case report are available to view in Appendix 1 (online at [www.jvsgbi.com](http://www.jvsgbi.com)). There was a higher prevalence of CaW reported in female patients (n=521) compared to male patients (n=295). Forty-four case reports did not describe the gender. The mean age of presentation was 43.7 years (range 29-93 years) across the case series and reports. The mean age range across the pooled registry/cohort studies was between 44-59 years. Fifty-five patients had concurrent bilateral carotid webs.<sup>3,25,38,42,47,49,67,106-109</sup> Only a third of the articles reported the ethnicity. A higher prevalence was reported in individuals of African descent, who represented 21% of the patient cohort (Afro-Caribbean n=101, African-American n=50, African n=14), followed by 10.5% of Caucasians (n=81). Other reported ethnicities included Asian (1.29%), Middle Eastern (0.52%) and Hispanic (0.52%). Where reported, almost 9% of the 212 patients (n=19) from the case series/case reports had a series of recurring symptoms at the time of presentation and diagnosis, although the time frame for these was not clear. All other reported cases were

**Figure 6** PRISMA Flowchart.



**Table 1** Short summary of findings and intervention, where reported

Studies included – cases from 1967-2024

Study Type	Number of Patients	Initial acute management	Subsequent/Definitive management	Outcomes
2 Registry reviews	559 patients	<ul style="list-style-type: none"> <li>Medical management (n=238)</li> <li>Thrombolysis (n=41)</li> <li>Thrombectomy (n=50)</li> <li>Reperfusion not otherwise specified (n=106)</li> <li>Decompressive hemicraniectomy (n=7)</li> </ul>	<ul style="list-style-type: none"> <li>Carotid artery stenting (n=228)</li> <li>Surgical (108)</li> </ul>	<ul style="list-style-type: none"> <li>55 patients – Bilateral Carotid Webs</li> <li>6 patients – known fibromuscular dysplasia</li> <li>No recurrence of symptoms after definitive management</li> </ul>
13 Cohort studies				
20 Case Series	212 patients	<ul style="list-style-type: none"> <li>Medical management (n=103)</li> <li>Thrombolysis (n=9)</li> <li>Thrombectomy (n=18)</li> <li>Thrombolysis and thrombectomy (n=8)</li> <li>Carotid artery stenting (n=18) and surgical (n=38)</li> <li>Not reported (n=23 cases)</li> </ul>	<ul style="list-style-type: none"> <li>Unchanged (n=118)</li> <li>Carotid artery stenting (n=28)</li> <li>Surgical (n=58)</li> <li>Further thrombectomy (n=1).</li> </ul>	<ul style="list-style-type: none"> <li>55 patients – Bilateral Carotid Webs</li> <li>6 patients – known fibromuscular dysplasia</li> <li>No recurrence of symptoms after definitive management</li> </ul>
73 Case reports				

**Table 2** Summary of patient demographics

Age	43.7 years (range 29-93)
Sex	71.66% - Female patients (n= 521) 22.64% - Male patients (n=295) 5.7% - Gender not reported
Ethnicity	21% - African/Afro-Caribbean (n=165) <ul style="list-style-type: none"> <li>Afro-Caribbean (n=101)</li> <li>African-American (n=50)</li> <li>African - not otherwise specified (n=14)</li> </ul> 10.5% - Caucasian (n=81) 1.29% - Asian <ul style="list-style-type: none"> <li>Asian – not otherwise specified (n=4)</li> <li>East Asian (n=4)</li> <li>South Asian (n=2)</li> </ul> 0.52% - Hispanic 0.52% - Middle Eastern Only 1/3 of all studies/cases reported the ethnicity
Co-morbidities	0.77% - Fibromuscular dysplasia 10.6% - Hypertension 5.45% - Hyperlipidaemia 3.3% - Diabetes

**Table 3** Short summary of reported management in case series/case reports

Initial management	Medical management <i>(Dual antiplatelet therapy or high dose single antiplatelet therapy)</i>	48.5% (n=103)
	Thrombolysis	4.2% (n=9)
	Thrombectomy	8.5% (n=18)
	Thrombolysis + thrombectomy	3.8% (n=8)
	Carotid artery stenting	8.5% (n=18)
	Surgical	17.9% (n=38)
	Not reported	10.8% (n=23)
Definitive/ Subsequent management	Carotid artery stenting	13.2% (n=28)
	Surgical	27.3% (n=58)
	Thrombectomy	0.47% (n=1)
	Unchanged	55.6% (n=118)

emergent or semi-emergent cases presenting with symptoms in the preceding hours or days. From the symptomatic case reports, 79% presented with TIA and 58.9% had stroke symptoms. There were 20% which did not specify the presentation or had atypical symptoms. The NIHSS score at presentation was provided in 54 case reports. The mean score was 7.7 at presentation (range 0-25). Six patients had a known pre-existing diagnosis of fibromuscular dysplasia.<sup>2,17,18,22,26,47,53,110</sup> The most commonly co-morbidities, where reported, were hypertension in 10.6% of the cohort, followed by hyperlipidaemia in 5.45% and diabetes in 3.3%.

All studies and case reports initially managed CaW with medical management or thrombolysis/thrombectomy.<sup>2,106-119</sup> However, further intervention with either stenting or surgery was required in a subset which comprised almost half the patient group who had

symptom recurrence or as a means to definitive management of the CW.<sup>2,106,108,109,111,112,115,116,119</sup> Of the 212 cases reported, the initial acute management included medical management with dual antiplatelet therapy or a high-dose single antiplatelet agent in 48.5% of the reported cases (n=103). 4.2% underwent thrombolysis (n=9), 8.5% underwent thrombectomy (n=18), 3.8% had thrombolysis and thrombectomy (n=8), 8.5% had carotid artery stenting (n=18) and 17.9% had surgical intervention (n=38). Initial management was not reported in 23 of the 212 cases. Subsequent, definitive management remained unchanged in more than 55.6% of the patients. However, further interval intervention included carotid artery stenting 13.2% (n=28), surgical 27.3% (n=58) and further thrombectomy 0.47% (n=1). None of the patients reported further symptoms following further definitive management.

Forty-five cases reported the intra-operative histology from the tissue samples sent. These are summarised in Table 5. Common findings included subintimal/intimal fibrosis (n=32) and medial muscular hyperplasia (n=12) and to a lesser degree, adventitial fibrosis (n=2). Associated thrombus was reported in 11 cases and arteriosclerosis or plaques were mentioned in seven cases.

**Table 4** Summary of studies included

Author	Year	Type of study	Number of patients	Age [in years]	Gender [Female: Male]	Ethnicity	Other patient descriptors	Acute Management	Recurrence	Definitive Management	Outcome
Joux <i>et al</i> (111)	2014	Cohort	25	Mean: 45.7±6.5	15F:9M	25 Afro-Caribbean	NR	Medical management (20/25 patients)	3/20- major strokes (NIHSS>10), 2/20 minor strokes (NIHSS<10), 1/20 TIA	1 Recurrent presentation underwent CEA. Surgical removal (7/25 patients)	Median time to recurrence = 12 months (earliest 1 month and all others after ≥6 months). Kaplan-Meier survival analysis: 1-, 2-, and 3-year recurrence rates in medically treated patients were 20% (95% confidence interval, 2.6–37.4), 27.3% (95% confidence interval, 6.3–48.3), and 36.4% (95% CI, 11.7–61.1). No recurrence in CEA patients.
Brinjikji <i>et al</i> (112)	2018	Cohort	4	Mean: 44 (range 30-50)	3F:1M	NR	NR	3-5 days of Ticagrelor		CAS	Post-operative bradycardia (n=3)
Haussen <i>et al</i> (113)	2018	Cohort	24	Median: 47 [IQR 41-61]	14F: 10M	17 African American; 7 Caucasian	NR	24/24 - Initial medical management; 11/24 - Thrombolysis; 13/24 - Thrombectomy	20 strokes; 4 TIAs (7 recurrent prior to stenting)	All underwent stenting + DAPT for 3 months followed by SAPT	No further symptoms
Pereira <i>et al</i> (114)	2018	Cohort	20	Mean: 50 (range 29-82)	10F:9M	NR	NR	13 - Supportive care NOS; 8 Stenting; 2 CEA; Aspirin and ticagrelor for 6 months then SAPT (Aspirin) up to 18 months.			No further symptoms
Haymes <i>et al</i> (110)	2020	Cohort	45 (7 had CaW, 15.6%)	Mean: 55 ± SD 12.6 (min 43, max 79)	5F:1M	4 African American; 1 Hispanic; 1 Caucasian	5/6 no significant cardiovascular disease risk factors, 1/6 Hypertension, Hyperlipidaemia, Former smoker, 1/6 Fibromuscular Dysplasia	Medical management - Aspirin	6 CEA 1 CAS		
Guglielmi <i>et al</i> (107)	2021	Registry	30	Median: 57 [IQR 46-66]	22F: 8M	NR	NR	28/30 - Medical management (15 on SAPT/ 8 on DAPT/ 4 on Warfarin/ 1 on DOAC)		1/30 - CEA after failing medical management	One death

continued...



**Table 4** Summary of studies included (continued 1)

Author	Year	Type of study	Number of patients	Age [in years]	Gender [Female: Male]	Ethnicity	Other patient descriptors	Acute Management	Recurrence	Definitive Management	Outcome
Rzepka <i>et al</i> (115)	2021	Cohort	181 (27 had CaW, 14.9%)	Mean: 66.70 years ± SD 14.34	16F:11M	NR	23 (85%) Hypertension, 14 (52%) Dyslipidaemia, 5 (19%) Atrial Fibrillation, 4 (15%) Diabetes Mellitus, 5 (19%) Smokers, 3 (11%) Myocardial Infarction, 8 (30%) ischaemic heart disease	All patients started on DAPT on diagnosis of ischaemic stroke + anticoagulation in 2 patients	54% CEA (n=27) 46% CAS (n=23)		
Samerano <i>et al</i> (108)	2021	Cohort	11	Median: 47 [IQR 38-50]	6F:5M	7 Sub saharan African; 3 North African; 1 Caucasian	NR	7/11 Thrombolysis; 4/11 Medical management with antiplatelets;	5/11 CAS 1/11 CEA		Modified Rankin Scale - 4 excellent outcome; 10 good outcome; 1 poor outcome. §§No deaths
Turpinat <i>et al</i> (109)	2021	Cohort	21	Mean: 50.6 +/-9.2	11F:10M	1 Asian, 16 Caucasian, 1 African/ Caucasian, 3 Middle eastern	NR	21/21- antiplatelet, 5/21- short term anticoagulation - 4/20 patients had at least one stroke recurrence before CaW stenting or on medical management. The annual recurrence rate on medical therapy was 11.4% (95% CI [8.4–15.1])	14/20- CAS		
Zhu <i>et al</i> (106)	2021	Cohort	8 (6 presented with acute ischaemic stroke)	Mean: 50.75 (range 38-65)	2F:6M	NR	NR	x1 Thrombolysis; + Medical management for all patients (Aspirin 100mg + Clopidogrel 75mg + Atorvastatin 40mg)	x2 CAS x1CEA		
Tabibian <i>et al</i> (2)	2022	Cross-sectional study	86 patients (all with CW, 14/86 acute ischaemic stroke, 72/86 asymptomatic)	Mean - stroke group 48.3 ± SD 9.9; Mean - asymptomatic group 46.4 ± 14.8	47F:39M (both groups)	NR	25/86 Hypertension 14/86 Hyperlipidaemia 1/86 Atrial Fibrillation 5/86 Diabetes Mellitus 31/86 Smoker 7/86 FMD	4/14 (28.6%) CEA 5/14 (35.7%) CAS 5/14 (35.7%) Aspirin alone			

continued...

**Table 4** Summary of studies included (continued 2)

Author	Year	Type of study	Number of patients	Age [in years]	Gender [Female: Male]	Ethnicity	Other patient descriptors	Acute Management	Recurrence	Definitive Management	Outcome
Zhou <i>et al</i> (116)	2022	Cohort	17 (all had CaW)	Mean age 59.41 years ±SD 10.66 years	4F:13M	NR	76.5% Hypertension 5.9% Dyslipidaemia 47.1% Diabetes Mellitus 11.8% Coronary artery disease 35.3% Previous stroke	7/17 medical management		9/17 CAS 1/17 CEA	No recurrence at median follow-up of 9 months (Inter quartile range 6–20 months)
Olindo <i>et al</i> (1)	2023	Registry	202 (32 with contralateral CaW)	50.8+/-12.2	62.9% F	47.5% Caucasian, 20.3% Afro-Caribbean	NR	106/185 - treatment of reperfusion; 21/185 thrombolysis; 37/185 thrombolysis and mechanical thrombectomy; 7/185 decompressive hemicraniectomy		80/110 – CAS 30/110– CEA 4/32 Contralateral CW's underwent Carotid Artery Stenting	33.3% anticoagulation (DOAC 85.7%, vitamin K antagonist 14.3%), 61.9% SAPT, 3.6% DAPT, 1.2% antiplatelet and anticoagulation; 4 patients had no further treatment (patient decision)
Osehobo <i>et al</i> (117)	2023	Cohort (2014–2021)	118 (88 athero-sclerotic disease, 30 CaW)	Mean 51.2	73.3% F	NR	NR	Dual antiplatelets		CAS	
Brinster <i>et al</i> (118)	2024	Cohort (2016–2022)	52	Mean 49 (range 29–73)	71% F	67% Afro-Caribbean	NR	All patients started on DAPT on diagnosis of ischaemic stroke + anticoagulation in 2 patients; 54% CEA (n=27), 46% CAS (n=23), 2 strokes nil intervention		When managed medically with DAPT + statin +/- anticoagulation for 10 patients, all suffered ipsilateral recurrent strokes; after intervention with a mean duration of 38 months, no post-intervention stroke or death	

CAS – Carotid Artery Stenting; CaW – Carotid Web; CEA – Carotid Artery Stenting; DAPT – Dual Antiplatelet Therapy; DOAC – Direct Oral Anticoagulant; F – Female; IQR – Interquartile range; M – Male; NHSS – National Institutes of Health Stroke Scale; NR – Not Reported; SAPT – Single antiplatelet therapy; SD– Standard Deviation; TIA – Transient Ischaemic Attack.

**Table 5** Summary of histology findings; 45 cases reported histology findings from intra-operative samples sent

Findings	Number of patients
Subintimal/Intimal Fibrosis	32
Medial Muscular Hyperplasia	12
Adventitial Fibrosis	2
Arteriosclerosis or Plaque	7
Thrombus	11
Myxoid degeneration	8
Inflammatory cell infiltration	3
Dissection	3

Other histological findings included myxoid degeneration (n=8), inflammatory cell infiltration (n=3) and dissection (n=3). Myxoid degeneration results in the accumulation of mucin in tendons, ligaments and fibrocartilage and its presence in CaW warrants further research to gain an understanding of the underlying pathology of CaW formation.

A single peri-partum case with bilateral CaW was also reported in a 39-year-old female with a history of ocular symptoms five years prior to presenting with left arm weakness. This was managed successfully with dual antiplatelet therapy, switched to low molecular weight heparin in the late third trimester and six weeks following delivery.<sup>67</sup> Further statistical analysis was not possible owing to missing data as well as the overall heterogeneity of the data available.

## Discussion

CaW are increasingly being recognised as a source of stroke for which no other causes may be identified leading to large vessel occlusion, particularly in younger patients.<sup>42,119</sup> Current imaging modalities include duplex ultrasonography, computed tomography angiography and high-resolution magnetic resonance angiography; however, CaW can be difficult to detect.<sup>103,106,116</sup> Barriers to diagnosis include lack of awareness and diagnosis with respect to imaging interpretation. Lesion identification can take up to four and a half months after initial stroke symptoms in as many as a quarter of patients.<sup>1</sup> CT angiography appears to be the most commonly used imaging modality in diagnosing and reporting CaW.<sup>1,106,107</sup> Duplex ultrasonography can be helpful as it provides information on the morphology of the CaW and can highlight haemodynamic changes, especially thrombus formation, but requires experience and expertise.<sup>106</sup> The literature comprises predominantly case reports and case series, with cohort and cross-sectional studies emerging in the last decade.

The true prevalence of CaW remains unknown. Registries such as MR CLEAN in the Netherlands and the CAROWEB in France have helped to shed light on this.<sup>1,15</sup> The CAROWEB registry, comprised of 224 cases, found that CaW were not identified at the time of mechanical thrombectomy in 30 out of the 85 patients.<sup>1</sup> The MR CLEAN registry found a 2.5% prevalence of CaW on the symptomatic side and a 0.5% prevalence on the asymptomatic side

in a cohort of 443 cases.<sup>107</sup> Similar to findings from the pooled evidence in this review, CaW were identified primarily on CTA in female patients in a younger age group. In our pooled cohort of cases series/case reports, symptoms recurred in just under half of all patients, requiring further definitive treatment. The MR CLEAN registry reported a recurrence rate of about 17% over a two-year period. The overall true recurrence rate is therefore not entirely clear. The results from these registries have helped to shape the current iteration of the European Society of Vascular Surgeons current guideline on CaW. The overall underdiagnosis of CaW is a possible factor in the recurrence of symptoms which would otherwise not yield any underlying causes for symptoms during initial investigations.

Current management options available include antithrombotic and antiplatelet medication, including aspirin, clopidogrel or a combination of both, and statin use. Immediate management in acute cases where there is evidence of large vessel occlusion with focal neurological changes includes thrombolysis and/or thrombectomy followed by either medical management or intervention. Carotid artery stenting is a minimally invasive option in patients who may otherwise be high risk or who opt for this option. Dual layer stents show positive results without significant complications.<sup>103</sup> Open surgical intervention can include endarterectomy and patchplasty, or web excision and anastomosis, as described in some reports.

In general, there appears to be a higher rate of symptom recurrence in patients managed medically.<sup>11,31,109,111,118,120</sup> The overall time to symptom recurrence varies between 1-97 months, with another study citing a median 12 months to symptom recurrence.<sup>31,111</sup> An annual symptom recurrence rate of up to 11.4% has been reported in patients on medical therapy alone.<sup>109,111</sup> Other studies reported that their cohort of patients with CaW presenting with transient ischaemic attacks progressed to cerebral infarction within three months of medical management in almost two-thirds of the cases.<sup>121</sup>

No further symptoms were reported after definitive intervention in the form of carotid artery stenting or carotid endarterectomy.<sup>106,111-113,115,116,117,120</sup> The risks and side effects associated with intervention also need to be considered and balanced with the frequency of symptom recurrence and future risk of symptom recurrence and risk of stroke. This also needs to be balanced with potential advances in endovascular methodology. The timing of definitive intervention also varies vastly and seems to be dependent on a number of factors, including symptom recurrence and surgeon preferences.

There seems to be a general lack of consensus in managing concurrent contralateral CaW without symptoms. The CAROWEB registry reported invasive intervention (primarily carotid stenting) in four of the 32 patients with contralateral CaW, which appears to show a slightly higher intervention rate for contralateral CaW in the US.<sup>4,120</sup> Consideration must also be given to the management of asymptomatic carotid webs which may be detected incidentally.



## KEY MESSAGES

- Carotid webs remain underdiagnosed and should be looked for in cases of stroke of undetermined cause
- The risk of symptom recurrence is generally high when managed medically. Definitive management options include carotid stenting or open surgery
- There is no clear guideline on how asymptomatic and concurrent bilateral carotid webs should be managed
- Establishing a registry will allow further research into this area

Little is known as to when CaW may occur, whether there is an embryological component and why symptoms present in young patients before the age of 60 but not earlier if CaW have been present for a long period. This also prompts the question as to whether these should be expectantly managed medically and whether early intervention could offset any potential risk of stroke in future. The optimal timing of any definitive intervention in asymptomatic patients also warrants further exploration.

The European Society of Vascular Surgeons current guideline on CaW recommends that for “*symptomatic patients with a carotid web in whom no other cause for stroke can be identified after detailed neurovascular work up, carotid endarterectomy or carotid artery stenting may be considered to prevent recurrent stroke*”.<sup>8</sup> This is based on Level C evidence, given the lack of consistent and sufficient data, and has been highlighted as an area warranting further research.<sup>8,122</sup> At present, these patients are managed on a case by case basis, with involvement of relevant specialities including radiologists, stroke physicians and vascular surgeons. There are also differing opinions on whether these cases should be managed with stenting or surgery as definitive management.

The current UK National Vascular Registry (NVR) reports data on patients undergoing carotid stenting and carotid endarterectomy and/or patchplasty. However, it does not report data on CaW and this in part may be due to the underdiagnosis or overall prevalence. Perhaps establishing a worldwide registry would allow uniformity in global reporting and help to establish the true incidence as well as allowing follow-up of the management and outcomes in these cases?

## Conclusion

Current literature on CaW lacks homogeneity and is mostly anecdotal in nature. Previous studies have focused on diagnosis, with emerging cohort studies in the last decade evaluating management options. Symptom recurrence is reduced following intervention in a subset of patients. However, the literature on the management of asymptomatic CaW is very limited.

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## Appendix/Supplementary Material

Author	Year	Study Type	Number of patients	Age	Gender	Ethnicity	Presenting Complaint	Co-morbidities	Family History	Smoking Status	NIHSS	Acute Management	Acute Management [details]	Definitive Management	Definitive Management [Details]		
Ehrenfeld et al (5)	1967	Case report	1	57	F	Caucasian	Left sided hemiplegia + intermittent dizziness	Hypertension, Bilateral thoracolumbar sympathectomy,	NR	NR	NR	Surgical	1st Operation - Right CEA + carotid resection + end to end anastomosis	Surgical	Surgical: 2nd Operation 2 weeks later - Left carotid resection and end to end anastomosis		
Connett et al (17)	1965	Case report	1	34	F	Caucasian	Right sided weakness, aphasia, facial weakness	Fibromuscular hyperplasia	NR	NR	NR	NR	NR	Surgical	L ICA- attempted open thrombectomy (could not remove clot); R ICA - Carotid resection		
Rainer et al (18)	1968	Case report	1	30	F	NR	3 month history of nocturnal right hemiparesis	Fibromuscular dysplasia	NR	NR	NR	NR	NR	Surgical	Carotid web excision and patch		
Gee et al (19)	1974	Case report	1	38	M	NR	12 hour history of right hemiparesis with complete resolution	NR	NR	NR	NR	NR	NR	Surgical	Proximal 2 cm of the internal carotid artery containing the lesion resected + autologous interposition saphenous vein graft.		
Lipchick et al (20)	1974	Case series	Case 1	50	M	NR	Transient ischaemic stroke symptoms NOS	NR	NR	NR	NR	NR	NR	Surgical	Surgical		
			Case 2	55	M	NR	Transient severe dizziness	NR	NR	NR	NR	NR	NR	NR	Surgical	Surgical	
			Case 3	58	M	NR	Transient aphasia + blindness	NR	NR	NR	NR	NR	NR	NR	Surgical	Surgical	
			Case 4	78	M	NR	Transient blindness	NR	NR	NR	NR	NR	NR	NR	NR	Surgical	Surgical
			Case 5	72	M	NR	Transient blindness over 2 years	NR	NR	NR	NR	NR	NR	NR	NR	Surgical	Surgical
Osborn et al (21)	1977	Case report	1	45	F	NR	Multiple TIAs NOS	NR	NR	NR	NR	NR	NR	Surgical	Surgical		



<b>So et al (22)</b>	1979	Case report	1	47	F	African American	Initial presentation - Left hemiparesis + aphasia + facial weakness and numbness. Represented almost 12 months later - left central facial palsy and left hemiparesis	High BMI, fibromuscular dysplasia	NR	NR	NR	Medical management	Medical management NOS	Surgical	CEA on representation
<b>Wirth et al (23)</b>	1981	Case series	Case 1	57	M	African American	Left sided transient weakness and sensory loss + carotid bruit	None	NR	NR	NR	Medical management	Aspirin and dipyridamole	Surgical	CEA 5 weeks later
			Case 2	71	M	African American	Severe headache and left sided weakness + carotid bruit		NR	NR	NR	NR	NR	Surgical	CEA 4 weeks later
<b>Kliwer et al (24)</b>	1991	Case report	1	34	F	NR	Cerebral Infarct	NR	NR	NR	NR	Surgical	Enderarterectomy	NR	NR
<b>Kubis et al (25)</b>	1991	Case series	Case 1	37	F	African	Right facial paresis + motor aphasia, frontal lobe syndrome	NR	NR	NR	NR	Medical management	Anticoagulation	Surgical	Surgical: excision of septum and reconstruction of megabulb
			Case 2	44	M	African	Mild left sided hemiparesis + left sensory extinction + left hemianopsia. Represented 12 months later with left hemiplegia.	NR	NR	NR	NR	Medical management	Aspirin	No change	Oral anticoagulation
			Case 3	38	M	African	Left sided hemiplegia with intense headache + left hemianopsia + bilateral Babinski sign. Comatose requiring intubation	NR	NR	NR	NR	NR	Patient died on admission	NR	N/A



<b>Morgenlander et al (26)</b>	1991	Case report	1	34	F	Caucasian	and ventilation Lightheadedness, facial droop, speech difficulty and right sided weakness	Fibromuscular dysplasia; on oral contraceptives	None	Smoker (15 pack year)	NR	Medical management	Warfarin	Surgical	CEA 6 weeks later + 325mg of Apsirin daily
<b>Gironell et al (27)</b>	1994	Case report	1	29	F	Asian (Philippines)	Sudden loss of strength in left limbs	NR	NR	NR	NR	Medical management	Aspirin 300 mg daily	Surgical	Arteriotomy (2 weeks later)
<b>Lenck et al (28)</b>	2013	Case series	Case 1	64	F	NR	Pulsatile tinnitus + bruit	NR	NR	NR	NR	NR	NR	Interventional radiology - stenting	
			Case 2	58	F	NR	Pulsatile tinnitus + bruit	NR	NR	NR	NR	NR	NR	NR	Interventional radiology - stenting
<b>Lenck et al (29)</b>	2014	Case report	Case 1	52	F	NR	NR	2 cardiovascular risk factors NOS	NR	NR	NR	Interventional radiology - stenting	Stenting	No change	
			Case 2	43	F	NR	NR	NR	NR	NR	NR	Interventional radiology - stenting	Stenting	No change	
<b>Fu et al (30)</b>	2015	Case report	1	76	F	Caucasian	Syncope	CABG (4 weeks earlier), MI, hypertension, hyperlipidaemia, pancytopenia, excess alcohol	NR	Smoker (50 pack year)	NR	Medical management	Medical management NOS	No change	
<b>Choi et al (31)</b>	2015	Retrospective series	Case 1	47	M	NR	Stroke NOS	Vascular risk factors NOS	NR	NR	NR	Surgical	On aspirin prior to representing	No change	
			Case 2	68	M	NR	TIA	NR	NR	NR	NR	Medical management	NR	No change	
			Case 3	78	F	NR	Stroke NOS	NR	NR	NR	NR	Medical management	NR	No change	
			Case 4	74	M	NR	Stroke NOS	Vascular risk factors NOS	NR	NR	NR	Medical management	NR	No change	
			Case 5	67	F	NR	Migraine	Vascular risk factors NOS	NR	NR	NR	Medical management	NR	No change	
			Case 6	55	F	NR	Left hemispheric TIA	Vascular risk factors NOS	NR	NR	NR	Medical management	NR	No change	

			Case 7	49	F	NR	Stroke NOS	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 8	57	M	NR	Peripheral vertigo	NR	NR	NR	NR	NR	Surgical	On aspirin prior to representing	No change			
			Case 9	64	M	NR	Benign neurological event	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 10	59	F	NR	Reversible cerebral vasoconstriction syndrome	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 11	53	F	NR	Stroke NOS	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 12	59	M	NR	Stroke NOS	Vascular risk factors NOS	NR	NR	NR	NR	Surgical	On aspirin prior to representing	No change			
			Case 13	51	M	NR	Stroke NOS	Vascular risk factors NOS	NR	NR	NR	NR	Medical management	NR	No change			
			Case 14	64	M	NR	Stroke NOS	Vascular risk factors NOS	NR	NR	NR	NR	Medical management	On aspirin prior to representing	No change			
			Case 15	72	M	NR	Benign neurological event	Vascular risk factors NOS	NR	NR	NR	NR	Surgical	On warfarin prior to representing	No change			
			Case 16	72	F	NR	Pneumonia	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 17	66	F	NR	Stroke NOS	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 18	39	F	NR	Optic neuritis	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 19	65	M	NR	Leptomeningeal metastasis	NR	NR	NR	NR	NR	Medical management	NR	No change			
			Case 20	90	F	NR	Stroke NOS	NR	NR	NR	NR	NR	Medical management	On aspirin prior to representing	No change			
			Case 21	72	M	NR	Seizure	Vascular risk factors NOS	NR	NR	NR	NR	Medical management	On warfarin prior to representing	No change			
			<b>Choi et al (33)</b>	2015	Prospective series	Case 1	54	M	Caucasian	x1 Recurrent stroke	None	NR	No	11	Surgical	On aspirin prior to representing (stopped 7 days prior) - Carotid endarterectomy	No change	
						Case 2	59	F	East Asian	x3 Recurrent strokes	Patent foramen ovale	NR	No	11	Surgical	On DAPT prior to representing - Carotid endarterectomy	No change	

			Case 3	44	F	South Asian	x1 Recurrent stroke	None	NR	No	0	Medical management	On aspirin prior to representing (stopped 7 days prior)	No change	
			Case 4	55	F	Caucasian	x1 Recurrent stroke	None	NR	No	14	Surgical	On clopidogrel prior to representing + Carotid endarterectomy	No change	
			Case 5	41	M	Caucasian	x1 Recurrent stroke	Migraine	NR	No	2,19	Surgical	On aspirin prior to representing +Carotid endarterectomy	No change	
			Case 6	49	F	South Asian	NR	None	NR	No	0	Medical management	NR	No change	
			Case 7	52	F	Caucasian	NR	None	NR	Yes	15	Medical management	NR	No change	
<b>Elmokadem et al (34)</b>	2016	Case report	Case 1	36	M	NR	Recurrent neurology (2nd presentation after 2 months) small vessel lacunar infarct	Hypertension	NR	No	NR	Interventional radiology - stenting	Medical management NOS	No Change	Carotid stenting + aspirin 81mg + clopidogrel75mg. Clopidogrel stopped after 3 months
			Case 2	41	F	NR	Recurrent neurology 4th presentation	None	NR	No	NR	Interventional radiology - thrombectomy	Thrombectomy + DAPT	Interventional radiology - stenting	Carotid stenting + post stenting angioplasty + aspirin 81mg + clopidogrel75mg. Clopidogrel stopped after 3 months.
<b>Phair et al (35)</b>	2017	Case report	1	43	F	NR	Acute left-sided weakness with a two-day history of severe bilateral frontal headache	NR	NR	NR	NR	Surgical	Right carotid endarterectomy 72 hours after the initial presentation	No change	Follow-up at 6 and 12 months, rehabilitation, follow-up to monitor her progress and functional restoration
<b>Martinez-Perez et al (36)</b>	2017	Case report	1	47	F	NR	Left sided hemiplegia + dysarthria	Herniated disc	NR	No	NR	Interventional radiology - thrombectomy	Thrombectomy	Interventional radiology - stenting	Carotid stenting + aspirin 81mg + clopidogrel75mg
<b>Sajedi et al (37)</b>	2017	Case series	Case 1	Mean age 38.3 (SD5.6)	1 M; 6 F	Caucasian	NR	2 Hyperlipidaemia + 3 Smokers	NR	NR	NR	Medical management	Supportive care - NOS	No change	
			African American			NR	NR		NR	Interventional radiology -	Thrombectomy	No change			

			Case 3				African American	NR		NR	NR	NR	thrombectomy Medical management	Supportive care - NOS	No change	
			Case 4				African American	NR		NR	NR	NR	Medical management	Supportive care - NOS	No change	
			Case 5				African American	NR		NR	NR	NR	Interventional radiology - thrombectomy	Thrombectomy	Surgical	Carotid endarterectomy
			Case 6				African American	NR		NR	NR	NR	Medical management	Supportive care - NOS	Surgical	Carotid endarterectomy
			Case 7				African American	NR		NR	NR	NR	Medical management	Supportive care - NOS	No change	
<b>Smyth et al (38)</b>	2017	Case report	Case 1	85	M	Caucasian	Right sided hemiparesis	Hypertension; Hyperlipidaemia; prostate cancer	NR	No	6	Interventional radiology - thrombolysis	Thrombolysis	No change	Aspirin 75mg + clopidogrel 75mg + statin	
		Case report	Case 2	38	M	Middle Eastern	Dense right sided hemiparesis + facial droop + aphasia	Previous stroke 15 months prior - SAPT (clopidogrel)	NR	NR	NR	Interventional radiology - Thrombolysis + thrombectomy	Thrombolysis + thrombectomy	No change	Dabigatran 150mg twice a day + aspirin 75mg once a day (Note: Patient had been on clopidogrel 75mg previously)	
<b>Kyaw et al (105)</b>	2018	Case report	1	20	F	Caucasian	Aphasia	None. On OCP	NR	No	6	Medical management	Aspirin 300mg + atorvastatin 80mg	No change	Aspirin + clopidogrel + atorvastatin	
<b>Munoz et al (39)</b>	2018	Case report	3	43	F	NR	x1 Recurrence after 11 months - Transient left hemiparesis initial presentation and on representation	None	NR	NR	NR	Medical management	Initially managed with DAPT on 1st presentation	Surgical	Carotid endarterectomy	
<b>Pacei et al (40)</b>	2018	Case report	2	36	F	NR	Frontal headache; right upper limb hemiplegia + tingling; right UMN facial palsy; mixed	NR	NR	No	NR	Medical management	Medical management (DAPT - aspirin 100mg + clopidogrel 75mg)	No change		

							receptive and expressive aphasia								
<b>Vercelli et al (41)</b>	2018	Case report	NR	47	M	NR	Episode of transient confusion and perioral tingling	NR	NR	NR	NR	Interventional radiology - thrombolysis	Intravenous tissue plasminogen activator, dual antiplatelet therapy for 3 months followed by aspirin monotherapy	No change	
<b>Wojcik et al (42)</b>	2018	Case Report	Case 1	45	F	NR	Left sided hemiparesis + facial droop	Previous R MCA syndrome 3 years prior treated with thrombolysis	NR	NR	NR	Medical management	Medical management - aspirin 325mg daily, heparin 5,000 units 8 hourly, atorvastatin 40 mg daily	Surgical	Carotid endarterectomy + patchplasty
			Case 2	44	F	NR	Left sided hemiplegia + mild headache + nausea	NR	NR	NR	NR	Interventional radiology - thrombectomy	Mechanical thrombectomy	Interventional radiology - stenting	Aspirin 325mg + clopidogrel 75mg for 3 months followed by aspirin only + 40mg atorvastatin
			Case 3	52	F	NR	Slurred speech + R facial droop, confusion, word finding difficulty	NR	NR	NR	NR	Interventional radiology - Thrombolysis	Thrombolysis	No change	Aspirin 81mg + clopidogrel 75mg + atorvastatin 40g
			Case 4	47	M	NR	Left facial numbness/tingling + L hand tingling	Hyperlipidaemia	NR	NR	NR	Medical management	Aspirin 81mg + clopidogrel 75mg + statin	No change	Dual antiplatelet therapy
			Case 5	51	F	NR	R sided weakness, aphasia, hemianopsia, facial droop	Hyperlipidaemia; lymphoma (in remission)	NR	NR	NR	Interventional radiology - thrombectomy	Thrombectomy + DAPT	Interventional radiology - stenting	DAPT for 1 month followed by 325mg aspirin + 10mg of atorvastatin
<b>Dudhiya et al (43)</b>	2019	Case report	1	48	M	NR	Sudden onset left-sided weakness and speech difficulties	NR	NR	NR	NR	Interventional radiology - thrombolysis + thrombectomy	Thrombolysis, transfer to a tertiary center for thrombectomy, carotid stent	Interventional radiology - stenting	
<b>Gouveia et al (44)</b>	2019	Case report	1	33	F	African American	Left sided hemiparesis + facial droop	None	NR	No	9	Interventional radiology - thrombolysis + thrombectomy	Thrombolysis + thrombectomy	Interventional radiology - stenting	Aspirin 81mg + clopidogrel 75mg + atorvastatin 10mg, clopidogrel
<b>Jennewine et al (45)</b>	2019	Case report	1	48	F	Caucasian	Right upper limb weakness	Protein S deficiency	NR	NR	NR	Medical management	DAPT at 1st presentation	Surgical	Carotid endarterectomy + patchplasty

							and dysphasia 2 years prior									
<b>Mac Groy et al (46)</b>	2019	Case report	1	67	M	NR	Left sided hemiparesis	Hypertension; hyperlipidaemia	NR	No	2	Medical management	81mg of aspirin daily	Interventional radiology - stenting	Recurrence prior to stent	
<b>Sajedi et al (47)</b>	2019	Case series	Case 1	48	F	Caucasian	Left MCA stroke - right sided weakness + aphasia	Cocaine use; fibromuscular dysplasia	NR	NR	NR	Medical management	Medical management (aspirin + anticoagulation)	No change		
			Case 2	45	M	African American	Right MCA stroke - temporal headache + left arm numbness		NR	NR	NR	NR	Surgical	Carotid endarterectomy	No change	
			Case 3	41	F	African American	Left MCA stroke - right sided hemiplegia + aphasia	Sickle cell	NR	NR	25	Interventional radiology - thrombolysis	Thrombolysis	Surgical	Carotid endarterectomy	
			Case 4	39	F	African American	Left MCA stroke NOS		NR	NR	NR	Medical management		No change		
			Case 5	35	F	African American	Right MCA stroke - left sided hemiplegia + slurred speech	Diabetes mellitus	NR	Yes	NR	Medical management		No change		
			Case 6	46	M	African American	Right MCA stroke NOS		NR	NR	NR	Medical management		No change		
			Case 7	28	F	African American	Left MCA stroke NOS		NR	NR	NR	Medical management		No change		
			Case 8	52	M	Hispanic	Incidental finding - left sided sensory changes		NR	NR	NR	NR		No change		
			Case 9	54	F	African American	Incidental finding - asymptomatic		NR	NR	NR	NR		No change		
			Case 10	37	F	African American	Incidental finding - syncope	Lumbar laminectomy and sural repair	NR	NR	NR	NR		No change		
			Case 11	41	F	African American	Chronic left MCA		NR	NR	NR	Medical management		No change		



			Case 12	48	M	African American	Chronic left MCA		NR	NR	NR	Surgical	Carotid endarterectomy (CEA)	No change	
			Case 13	37	F	African American	Chronic right MCA - Right sided hemiplegia 4 years prior		NR	NR	NR	Medical management		No change	
			Case 14	37	F	African American	NR		NR	NR	NR	NR		No change	
<b>Vercelli et al (41)</b>	2019	Case report	1	47	M	NR	Episode of transient confusion and perioral tingling, acute-onset left upper motor neuron facial paresis, dysarthria, and left hand paresthesias two years later	NR	NR	NR	NR	Interventional radiology - thrombolysis	Intravenous tissue plasminogen activator (tPA), dual antiplatelet therapy for 3 months, aspirin monotherapy, neurological examination was normal after 2 hours following the administration of intravenous tissue plasminogen activator	No change	
<b>Bennani et al (48)</b>	2020	Case report	1	54	M	NR	Right sided hemiplegia + aphasia + homonymous lateral hemianopia	None	NR	No	NR	Interventional radiology - thrombolysis	Thrombolysis	Surgical	Carotid endarterectomy
<b>Hassani et al (49)</b>	2020	Case series	Case 1	5th decade	NR	NR	Left MCA stroke NOS	Hypertension; Hyperlipidemia	NR	Yes	4	Interventional radiology - thrombectomy	Thrombectomy + aspirin	No change	
			Case 2	5th decade	NR	NR	Right MCA stroke NOS	Diabetes mellitus, asthma	NR	No	12	Interventional radiology - thrombectomy	Thrombectomy + apixaban	No change	
			Case 3	6th decade	NR	NR	Right MCA stroke NOS	Hypertension	NR	No	16	Medical management	Medical management (DAPT - aspirin + clopidogrel)	No change	
<b>Liu et al (50)</b>	2020	Case report	1	52	M	NR	NR	None	None	No	NR	Medical management	Antiplatelet + statin	No change	

<b>Krasteva et al (51)</b>	2020	Case report	1	47	F	NR	Sudden episode of left-sided sensory disturbance, followed by a weak left hand grip after stumbling while climbing stairs	None	None	NR	NR	Interventional radiology - stenting	Conservative therapy with aspirin 100 mg/d, clopidogrel 75 mg/d, and atorvastatin 80 mg/d, CGuard stent was deployed in the right extracranial carotid artery	No change	
<b>Ning et al (52)</b>	2020	Case report	1	65	M	Han Chinese	Intermittent dizziness and slurred speech for 1.5 years, as well as numbness in both upper limbs for 4 months	Diabetes (17 years), hypertension (10 months)	NR	Smoker (20 years)	NR	Surgical	Carotid endarterectomy (CEA)	No change	
<b>Ozaki et al (53)</b>	2020	Case report	1	48	F	NR	Right sided hemiparesis	Fibromuscular dysplasia	NR	NR	11		Thrombectomy + DAPT	Surgical	Carotid endarterectomy 2 months later + DAPT for 1 year, switched to SAPT (aspirin)
<b>Priyadarshni et al (54)</b>	2020	Case report	1	54	F	NR	Right sided facial warmth and tongue paraesthesia, occipital headache	Hypertension, hyperlipidaemia, ischaemic stroke with residual left-sided hemiparesis	NR	NR	NR	Medical management	IV heparin and DAPT with aspirin and clopidogrel	No change	
<b>Ren et al (55)</b>	2020	Case report	1	48	M	NR	Right sided weakness and numbness. Represented 1 month later with right sided weakness + lethargy	NR	NR	NR	NR	Surgical	Superficial temporal artery to MCA bypass	No change	
<b>Watanabe et al (56)</b>	2020	Case report	1	NR ("in 40s")	NR	NR	Left-sided hemiparesis	None	No FMH of stroke	Non-smoker	NR	Medical management	Heparin infusion, subsequently changed to DAPT + anticoagulant	Interventional radiology - stenting	
<b>Borghese et al (57)</b>	2021	Retrospective series	Case 1	52	M	Asian		3 Hypertension	NR	x1 smoker	9,2	Interventional radiology -	Thrombectomy	Surgical	Web excision + patch angioplasty

			Case 2	44	F	Caucasian		n; 3 high BMI	NR		6,4	Interventional radiology - thrombectomy	Thrombectomy	Surgical	+75mg aspirin (indefinitely)
			Case 3	49	F	Caucasian			NR		6,3	NR		Surgical	Web resection + end-to-end anastomosis +75mg aspirin (indefinitely)
			Case 4	44	M	Caucasian			NR		4,0	NR		Surgical	Web resection + end-to-end anastomosis + 75mg aspirin (indefinitely)
			Case 5	53	F	Caucasian			NR		17,15	Interventional radiology - thrombectomy	Thrombectomy	Surgical	Web resection + end-to-end anastomosis + 75mg aspirin (indefinitely)
<b>Bouchal et al (58)</b>	2021	Case report	1	58	M	NR	Sudden onset left-sided weakness, numbness and speech difficulty which lasted 90 minutes	NR	NR	Smoker	13	Medical Management	Intravenous tissue plasminogen activator (IVT) alteplase at 2 hours and 15 minutes after the onset of symptoms, IVT 10 days after the first stroke, resulting in dramatic improvement, stenting 2 days after the last stroke	No change	Dual antiplatelet agents (aspirin 100 mg and clopidogrel 75 mg) and atorvastatin (20 mg daily),
<b>Calle La Rosa et al (6)</b>	2021	Case report	1	35	F	NR	Weakness in both right limbs and a sudden-onset language disorder	No (spontaneous abortion in the first trimester of pregnancy, three years before the current event and without any complications)	NR	NR	13	Medical management	Aspirin (100 mg/day) as the primary medical treatment	No change	Two-year follow-up
<b>Essibayi et al (59)</b>	2021	Case report	1	51	F	NR	Sudden onset of aphasia, right hemi-sensory loss, and right visual field cut	Mitral valve prolapse and migraines with visual aura	NR	NR	NR	Medical management	Clopidogrel and a high-intensity statin, discontinuation of oral contraceptive, rheumatological	No change	Plavix monotherapy, with a 10-month follow-up showing no recurrent ischemic events

<b>Gao et al (60)</b>	2021	Case report	1	50	M	NR	Left arm weakness and slurred speech	Diabetes	NR	Yes	NR	Interventional radiology - thrombolysis + thrombectomy	and genetic evaluation 0.06 mg/kg IV thrombolysis bridging mechanical thrombectomy	Surgical	Carotid endarterectomy after 30 days + combined antiplatelet and anticoagulant therapy, atorvastatin 40 mg
<b>Gao et al (61)</b>	2021	Case report	1	65	M	NR	Left limb weakness accompanied by a headache & dizziness for 4 hours, moderate left hemiplegia, neglect, and sensory loss	Hypertention (4 years), poor blood pressure control, hyperlipidemia (>20 years)	NR	NR	8	Medical management	Dual antihypertensive therapy, including aspirin, clopidogrel, enoxaparin sodium and atorvastatin to manage hyperlipidemia	No change	Continuation of aspirin therapy, with a reduction to single antiplatelet aspirin after 2 months
<b>Giammello et al (62)</b>	2021	Case report	1	63	F	NR	Right-sided weakness, aphasia, reduced speech output, hemiparesis, slight hypoesthesia on the right side, and motor aphasia	Arterial hypertension, dyslipidemia	NR	Smoker	19	Interventional radiology - thrombolysis + thrombectomy	Intravenous thrombolysis with recombinant tissue plasminogen activator (IV rT-PA), 3 mechanical thrombectomies, stent replacement in left common carotid artery and internal carotid artery, dual platelet therapy (DAPT) with acetylsalicylic acid (ASA) and clopidogrel.	No change	Low dose aspirin, continued dual antiplatelet therapy (DAPT)
<b>Mathew et al (63)</b>	2021	Retrospective series	Case 1	48	F	Hispanic	Stroke NOS	NR	NR	NR	NR	NR	Started on DAPT (aspirin 325mg +clopidogrel 75mg) for 5 days prior to stenting	Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 2	59	M	African American	Stroke NOS	NR	NR	NR	NR	NR		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 3	37	F	African American	Vertigo	NR	NR	NR	NR	NR		Surgical	Carotid endarterectomy + patchplasty

			Case 4	56	F	Hispanic	Stroke NOS	NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 5	60	F	African American	Stroke NOS	NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 6	56	M	African American	Stroke NOS	NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 7	62	F	African American	Stroke NOS	NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 8	59	M	Caucasian	Stroke NOS	NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 9	56	F	African American	Vertigo	NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
			Case 10	64	F	Asian		NR	NR	NR	NR	Medical management		Interventional radiology - stenting	Carotid stenting + aspirin 81mg (switched from DAPT at 6 week follow-up)
<b>Mehra et al (64)</b>	2021	Case report	1	31	F	NR	Visual aura, headache, intermittent paraesthesia of left fifth digit of hand	NR	Migraine	NR	NR	Surgical	Apixaban, right ICA web excision and arteriotomy repaired with GSV patch angioplasty	No change	Single antiplatelet agent
<b>Mi et al (65)</b>	2021	Case report	1	53	M	NR	3-day history of severe bilateral frontal headache, accompanied by a sudden onset of sluggish responses, cognitive decline, particularly in calculations	None	None	NR	NR	Interventional radiology - stenting	Carotid stent placement, aspirin and clopidogrel therapy were continued for 3 months, followed by aspirin indefinitely	No change	Follow-up at 3 months with (CTA), and continuous monitoring due to mild cognitive impairment

Multon et al (3)	2021	Prospective series	Case 1	38	6M:5 F	9 Afro-Caribbean; 2 Caucasian	11 Symptomatic; 5 asymptomatic (6 had recurrent symptoms at presentation)	Hyperlipidaemia, migraine	NR	NR	1	Surgical	Internal carotid resection and anastomosis + contralesional CEA and patchplasty 23 days later + SAPT for 6-12 months	No change	
			Case 2	49				None	NR	NR	0	Surgical	CEA + patchplasty + SAPT for 6-12 months	No change	
			Case 3	41				Hyperlipidaemia, hepatitis B	NR	NR	0	Surgical	Internal carotid resection and anastomosis - contralesional side 54 days later + SAPT for 6-12 months	No change	
			Case 4	60				Hyperlipidaemia, fenestrated endovascular aneurysm repair	NR	NR	2	Surgical	Carotid stenting - contralesional side 551 days later + SAPT for 6-12 months	No change	
			Case 5	53				Pituitary adenoma	NR	NR	1	Surgical	Internal carotid resection and anastomosis - contralesional side 167 days later + SAPT for 6-12 months	No change	
			Case 6	41				Meniere's disease	NR	NR	0	Surgical	Internal carotid resection and anastomosis + contralesional CEA and patchplasty 23 days later+ SAPT for 6-12 months	No change	
			Case 7	44				Migraine	NR	yes	0	Interventional radiology - stenting	Stenting - DAPT for 3 months then SAPT	Surgical	Internal carotid resection and anastomosis
			Case 8	41				Hypertension; Hyperlipidaemia	NR	NR	4	Interventional radiology - stenting		Surgical	CEA + patchplasty
			Case 9	43				Uterine myoma	NR	NR	15	Interventional radiology - stenting		Surgical	CEA + patch angioplasty
			Case 10	34				None	NR	NR	18	Interventional radiology - stenting		Surgical	Carotid stenting - contralesional internal carotid resection and anastomosis 147 days later



			Case 11	40				None	NR	NR	25	Interventional radiology - stenting		Surgical	Internal carotid resection and anastomosis
<b>Ono et al (66)</b>	2021	Case report	1	43	F	NR	Transient right hemiparesis + aphasia	None	NR	No	NR	Medical management	Clopidogrel 75mg monotherapy	Interventional Radiology - Thrombectomy	Represented 17 months later with R hemiparesis and dysarthria. New occlusion in left M1 region on CT. Recurrence prior to thrombectomy. Discharged with rivaroxaban + clopidogrel.
<b>Thomas et al (67)</b>	2021	Case report	1	39	F	NR	Left arm weakness - pregnant with twins; 30-min episode of onset left upper limb weakness, slurred speech and left-sided blurred vision 5 years earlier.	Migraine, Raynaud's, eczema, 2 previous pregnancies	NR	Smoker 10/day	NR	Medical management	DAPT	No change	DAPT (75mg aspirin + 75mg clopidogrel) - Temporarily switched to prophylactic low molecular weight heparin late third trimester and 6 weeks following delivery via C-section
<b>Yin et al (68)</b>	2021	Case report	1	37	F	NR	Left hemiparesis, somnolence, gaze paralysis	None	NR	NR	NR	Interventional radiology - thrombectomy	Stent retriever embolectomy	No change	Aspirin 100 mg/day, clopidogrel 75 mg/day, atorvastatin 40 mg/day, then carotid endarterectomy 20 days post-stroke

<b>Zhiyong et al (69)</b>	2021	Case report	1	59	M	NR	Acute right hemispheric syndrome	No cardiovascular risk factors	NR	No	NR	Interventional radiology - thrombectomy	Combination therapy of IV thrombolysis and mechanical thrombectomy	No change	Planned for elective surgery to carotid web and thrombus. However, patient had recurrence of symptoms 5 days later with MCA reoccluded and thrombus disappeared, no further information provided.
<b>Alnajjar et al (70)</b>	2022	Case report	1	64	M	Indian	Left-sided weakness on both presentation 1 and 2	Diabetes mellitus, hypertension, recent right corona radiata stroke	NR	NR	NR	Medical management	Presentation 1: DAPT, discharged to stroke rehabilitation facility	Interventional radiology - stenting	Presentation 2: carotid stenting - DAPT
<b>Charifi et al (71)</b>	2022	Case series	3	36	M	NR	Left hemiplegia and dysarthria	Facial paralysis 2 months prior	NR	NR	NR	Medical management	Intravenous recombinant tissue plasminogen activator - no improvement, patient rejected endovascular therapy	No change	100 mg aspirin and 75 mg clopidogrel
				36	F	NR	Right hemiplegia	TIA 6 months prior	NR	NR	NR	Medical management	Oral dual antiplatelet therapy, IV UFH 100 U/H, right carotid stent after 20 days medical treatment	Interventional radiology - stenting	Planned left carotid stent 1 month later, long-term antiplatelet therapy with aspirin and clopidogrel
				40	F	NR	Left hemiparesis	Hypertension, right ischaemic stroke 1 year prior	NR	NR	NR	Interventional radiology - stenting	Emergency endovascular stenting of internal carotids, heparin with statin during hospitalisation	No change	Life-long DAPT

<b>Gillgren et al (72)</b>	2022	Case report	1	32	M	African	Left-sided hemiplegia, aphasia, and central facial nerve palsy	None	None	Non-smoker	11	Surgical	Dual antiplatelet therapy (aspirin and clopidogrel) for 3 weeks, followed by a single aspirin and atorvastatin at 40 mg; Welectomy surgery and discharged with a prescription for aspirin for 4 months, and atorvastatin was discontinued after 1 month	No change	Recovery; MRI as part of long-term follow-up
<b>Gour et al (73)</b>	2022	Case report	1	39	F		Speech impairment, weakness, and sensory disturbances in left limbs	No cardiovascular risk factors except increased BMI	NR	Not directly reported but assuming non-smoker as it states no CV risk factors	NR	Medical management	Dual antiplatelet therapy and statin	No change	Dual antiplatelet therapy
<b>Hadwen et al (74)</b>	2022	Case report	1	61	M	NR	Stroke syndrome, characterized by left hemiplegia and left hemineglect	NR	NR	NR	NR	Interventional radiology - thrombectomy	Thrombectomy to recanalise the occluded right middle cerebral artery	Interventional radiology - stenting	Antiplatelet therapy (aspirin) later switched to dual antiplatelet therapy, carotid stenting due to symptom recurrence
<b>Ishikawa et al (75)</b>	2022	Case report	1	51	M	NR	Consciousness disturbance, left hemiparesis	NR	NR	NR	NR	Interventional radiology - thrombectomy	Mechanical thrombectomy	Interventional radiology - stenting	DAPT, stent placement 3 weeks after admission
<b>Khaladkar et al (76)</b>	2022	Case report	1	44	F	NR	Left upper and lower limb weakness associated with ipsilateral	None	None	Non-smoker	NR	Medical management	Conservative treatment with dual oral antiplatelet therapy, anticoagulant injections, and statins	No change	DAPT + anticoagulation + statin

							facial weakness								
<b>Kodankandath et al (77)</b>	2022	Case report	1	55	F	Caucasian	Acute onset of aphasia and right-sided hemiparesis	No	NR	NR	NR	Interventional radiology - thrombectomy	IV tissue plasminogen activator, mechanical thrombectomy	Interventional radiology - stenting	6 months, follow-up neck CTA, elective stenting of carotid web, antiplatelet therapy
<b>Mesnaoui et al (78)</b>	2022	Case report	Case 1	30	F	NR	Right sided hemiplegia	NR	NR	NR	NR	Interventional radiology - stenting	Carotid stenting	No change	Monotherapy
			Case 2	45	NR	NR	Left sided hemiplegia	NR	NR	NR	NR	Interventional radiology - thrombolysis	Thrombolysis at 3 hours with complete recovery	Surgical	Surgical thrombectomy and thromboendarterectomy at Day 8
			Case 3	65	NR	NR	Left sided hemiparesis	NR	NR	Yes	NR	Surgical	Surgery - thrombectomy + carotid thromboendarterectomy	No change	NR
			Case 4	50	F	NR	Headache + dizziness	Cardiovascular risk factors NOS	NR	NR	NR	NR	Interventional radiology - stenting	Angioplasty + stenting	No change
<b>Miranda et al (79)</b>	2022	Case report	1	47	F	NR	Left face and upper limb sensorimotor deficits	NR	NR	NR	11	Interventional radiology - stenting	Endovascular stenting of the right internal carotid web and reintroduction of aspirin 100 mg daily. Acute reperfusion therapy was contraindicated due to late hospital admission	No change	Medical management, antiplatelet therapy, and revascularization procedures
<b>Oushy et al (80)</b>	2022	Case report	1	43	F	NR	Recurrent right hemispheric stroke - 3 previous MCA infarcts from age 36	On OCP. Patent foramen ovale	NR	No	NR	Medical management	Previously on DAPT but had haemorrhagic transformation	Interventional radiology - stenting	Carotid stenting + DAPT

Rodriguez-Castro et al (81)	2022	Case series	1	40s	NR	NR	5 month history of recurrent episodes of right limb paresis and motor aphasia	No vascular risk factors	NR	Non-smoker	NR	Medical management	Admission 1 - patient discharged home on single antiplatelet therapy, no acute treatment with IV fibrinolysis or mechanical thrombectomy on either admission	Surgical	Carotid endarterectomy due to symptom recurrence
			2	40s	NR	NR	NR	No vascular risk factors	NR	Non-smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Surgical	Carotid endarterectomy
			3	60s	NR	NR	NR	Hypertension, dyslipidaemia	NR	Non-smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Surgical	Carotid endarterectomy
			4	60s	NR	NR	NR	Hypertension	NR	Non-smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Surgical	Carotid endarterectomy
			5	50s	NR	NR	NR	No vascular risk factors	NR	Non-smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Interventional radiology - stenting	Stenting
			6	50s	NR	NR	Transient left hemiparesis	Hypertension, dyslipidaemia	NR	Non-smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy, patient discharged on dual antiplatelet therapy	Surgical	CTA repeated one month later - resolution of superimposed thrombus and typical CW seen, carotid endarterectomy done

			7	50s	NR	NR	NR	No vascular risk factors other than smoker	NR	Smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Surgical	Carotid endarterectomy
			8	50s	NR	NR	NR	Hypertension	NR	Non-smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Surgical	Carotid endarterectomy
			9	40s	NR	NR	NR	Hypertension	NR	Smoker	NR	Medical management	No acute treatment with IV fibrinolysis or mechanical thrombectomy	Surgical	Carotid endarterectomy
<b>Schutt et al (82)</b>	2022	Case series	Case 1	47	M	Afro-Caribbean	Right arm and face weakness, mild expression aphasia, right-left confusion	Nil significant	NR	NR	NR	Interventional radiology - stenting	Carotid stenting	No change	DAPT + atorvastatin
			Case 2	48	F	Afro-Caribbean	Right gaze deviation, left sided dense hemiplegia, sensory loss and neglect	Mild hypertension, diet-controlled hyperlipidaemia	NR	NR	NR	Interventional radiology - thrombectomy	Thrombectomy for right MCA occlusion, followed by CEA 3-days post-stroke	Surgical	Carotid endarterectomy + aspirin + atorvastatin
			Case 3	39	F	Afro-Caribbean	Painless vision loss in right eye + left hemiparesis	Nil significant	NR	NR	NR	Interventional radiology - stenting	NR	No change	DAPT for 3 months, then transitioned to aspirin monotherapy
<b>Shen et al (83)</b>	2022	Case report	1	42	M	NR	x1 Recurrent stroke - right hand weakness + dizziness. Represented with intermittent weakness and numbness in the right upper limb	Hypertension	NR	Yes	7, 6	Interventional radiology - thrombolysis	Thrombolysis	Surgical	Medical management with DAPT. Carotid endarterectomy on Day 3 on representation; discharged on SAPT (Aspirin)
<b>Zhang et al (84)</b>	2022	Case report	1	38	M	Asian	Left hemispheric syndrome + transient	Nil significant	NR	Current smoker	NR	Interventional radiology -	Mechanical thrombectomy, followed by DAPT		Continued on DAPT, repeat CTA showed unchanged



							aphasia 1 month prior					thrombectomy		stenosis of carotid bulb, underwent CEA 56 days after initial management	
<b>Zhang et al (85)</b>	2022	Case report	NR	55	M	NR	Weakness in the left limb	Type 2 diabetes (7 years)	NR	NR	NR	Surgical	CEA	NR	
<b>Assid et al (86)</b>	2023	Case report	NR	30	F	African-American	Left upper and lower extremity hypoesthesia and slurred speech 1 hour prior to arriving to + numbness and slurred speech progressed	Obesity (BMI 43.3 kg/m <sup>2</sup> ), 10 months post-partum	Stroke	Non-smoker	0 (on second day of administration)	Surgical	Right carotid endarterectomy, drug-related therapies (ticagrelor 90 mg twice daily, amlodipine 5 mg once daily, and aspirin 81 mg once daily),	Ticagrelor 90 mg once a day, ongoing monitoring	
<b>De Lorenzo et al (87)</b>	2023	Case report	1	54	F	NR	Right sensory-motor	Nil significant	None	Smoker	2	Medical management	Started on DAPT after stroke suspected, followed by left CAS after 1 week of antithrombotic treatment	Surgical	Further thrombophilia workup normal, continued on DAPT for 3 months, then SAPT
<b>Fanning et al (88)</b>	2023	Case report	NR	26	F	NR	5 hours of acute right neck pain and left arm weakness after exercising	NR	NR	NR	3	Surgical	Transferred to a comprehensive stroke centre for further management, no thrombolytic therapy, carotid endarterectomy (CEA)	Post CEA monitoring	
<b>Faye et al (89)</b>	2023	Case report	2	30	F	NR	Aphasia and left upper limb weakness	NR	NR	NR	8	Medical management	Antiplatelet	No change	None (surgical treatment was refused)
				54	M	NR	Sudden presentation with speech disorder and right sided weakness	NR	NR	NR	11	Medical management	Antiplatelet	No change	Antiplatelets curative treatments, discharge without carotid endarterectomy surgery and stenting
<b>Kamatani et al (90)</b>	2023	Case series	Case 1	79	M	NR	NR	Hypertension, hyperlipidaemia	NR	NR	NR	Medical management	DAPT for 10 days prior to CAS	Surgical	DAPT for 6 months
			Case 2	80	M	NR	NR	Hypertension, DM,	NR	NR	NR	Medical management	DAPT for 10 days prior to CAS	Surgical	

			Case 3	93	F	NR	NR	hyperlipidaemia	NR	NR	NR	Medical management	DAPT for 10 days prior to CAS	Surgical	
			Case 4	74	F	NR	NR	Nil significant	NR	NR	NR	Medical management	DAPT for 10 days prior to CAS	Surgical	
			Case 5	79	F	NR	NR	Hypertension, hyperlipidaemia	NR	NR	NR	Medical management	DAPT for 10 days prior to CAS	Surgical	
			Case 6	86	M	NR	NR	Hypertension	NR	NR	NR	Medical management	DAPT for 10 days prior to CAS	Surgical	
<b>Kasashima et al (91)</b>	2023	Case report	NR	67	M	NR	Upper right limb weakness and ataxia	Hypertension, dyslipidaemia, type 2 diabetes	NR	NR	NR	Medical management	Aspirin and clopidogrel, argatroban hydrate infusion, left carotid endarterectomy (CEA)	Surgical	100 mg/day of aspirin and 75 mg/day of clopidogrel following the initial treatment
<b>Kawahara et al (92)</b>	2023	Case report	NR	40	M	Caucasian	Sudden onset of left-sided facial droop, hemiparesis, and dysarthria	No	NR	Tobacco chewing	NR	Interventional radiology - thrombolysis + thrombectomy	Thrombolysis and alteplase, mechanical thrombectomy, CEA (on hospital day 5)	Surgical	Continued on aspirin 81 mg and atorvastatin 10 mg daily. Outpatient follow-up 4 and 12 weeks
<b>Lkharrat et al (93)</b>	2023	Case report	NR	35	F	NR	Acute right hemiplegia with facial palsy evolving for 30 minutes	No	NR	NR	14	Interventional radiology - thrombolysis + thrombectomy	Thrombolysis with 0.25 mg/kg of tenecteplase, stenting of carotid bulb	Interventional radiology - stenting	Dual antiplatelet therapy was continued for three months, followed by aspirin indefinitely
<b>Naito Gomi et al (94)</b>	2023	Case report	1	87	F	NR	Left hemiparesis + hemiparaesthesia 2 years before referral	None	NR	NR	NR	Medical management	Clopidogrel on initial stroke; no surgical management reported	No change	NR
<b>Radu et al (95)</b>	2023	Case series	Case 1	50s	M	NR	2 recurrent left-sided ischaemic strokes	NR	NR	NR	NR	Medical management	Aspirin, clopidogrel, apixaban for 2 months	Interventional radiology - stenting	NR
			Case 2	50s	M	NR	2 previous right-sided ischaemic strokes	NR - on aspirin and rivaroxaban during initial investigations	NR	NR	NR	NR	Interventional radiology - stenting	CAS	No change

			Case 3	50s	M	NR	Right-sided ischaemic stroke	NR	NR	NR	NR	Interventional radiology - stenting	CAS	No change	NR
<b>Vukasović et al (96)</b>	2023	Case report	1	46	F	Caucasian	Left temporal headache accompanied with flashes in the right half of the visual field	Hypertension	NR	No	N/A	Medical management	Aspirin 100mg + amlodipine 5mg	No change	NR
<b>Wang et al (97)</b>	2023	Case series	Case 1	42	M	NR	Ischaemic stroke	No	NR	Non-smoker	3	Surgical	Complete carotid web resection	No change	NR
			Case 2	41	F	NR	Ischaemic stroke	Hypertension	NR	Former smoker	0	Surgical	Endarterectomy	No change	NR
			Case 3	57	F	NR	Ischaemic stroke	No HTN, no DM	NR	Non-smoker	0	Surgical	Complete carotid web resection	No change	NR
			Case 4	57	F	NR	TIA - right amaurosis fugax	Hypertension	NR	Former smoker	0	Surgical	Complete carotid web resection	No change	NR
			Case 5	36	M	NR	Ischaemic stroke	No HTN, no DM	NR	Non-smoker	2	Surgical	Complete carotid web resection	No change	NR
			Case 6	31	F	NR	Ischaemic stroke	No HTN, no DM	NR	Non-smoker	4	Surgical	Complete carotid web resection	No change	NR
			Case 7	39	F	NR	Ischaemic stroke	No HTN, no DM	NR	Non-smoker	13	Surgical	Endarterectomy	No change	NR
			Case 8	47	F	NR	Ischaemic stroke	No HTN, no DM	NR	Current smoker	0	Surgical	Complete carotid web resection	No change	NR
			Case 9	44	F	NR	Ischaemic stroke	No HTN, no DM	NR	Non-smoker	11	Surgical	Complete carotid web resection	No change	NR
<b>Wang et al (98)</b>	2023	Case report	1	49	M	NR	Aphasia + right limb weakness	Stroke	NR	NR	NR	Interventional radiology - thrombolysis	IV thrombolysis with rt-PA 0.9 mg/kg, subsequent attempt at thrombectomy but was abandoned as occluded segment of MCA had recanalized, 60 hours thrombolysis, subsequently emergent carotid endarterectomy	Surgical	NR (but this is a case report of recurrent stroke where patient was on antiplatelet drugs and statins prior to admission)

<b>Xu et al (99)</b>	2023	Case report	1	59	M	NR	Recurrent numbness and weakness of right upper extremity, previously had light-headedness and left amaurosis during neck flexion (therefore took aspirin 100 mg/day)	NR	NR	NR	NR	NR	NR	Surgical	Carotid endarterectomy and left styloidectomy performed simultaneously
<b>Yang et al (100)</b>	2023	Case report	1	43	F	NR	An acute onset of left limb weakness and slurred speech within 3 hours, which led to her admission to the emergency department. This was accompanied by a National Institutes of Health Stroke Scale (NIHSS) score of 12	None	None	Non-smoker	12	Interventional radiology - thrombolysis + thrombectomy	Intravenous thrombolysis (rt-PA), mechanical thrombectomy to achieve recanalisation of the occluded right middle cerebral artery, anticoagulation therapy	No change	Rehabilitation 2 weeks after initial treatment; 2 month follow-up to repeat CTA
<b>Yin et al (101)</b>	2023	Case report	1	63	M	NR	No presenting complaint; routine ultrasound examination	Hypertension	None	NR	NR	Surgical	Carotid endarterectomy	No change	NR
<b>Zelada-Rios et al (102)</b>	2023	Case series	1	37	F	NR	Ischaemic stroke, specific symptoms NR	None	NR	NR	NR	Medical management	Aspirin	No change	Aspirin 100 mg/day, atorvastatin 40 mg/day
			2	43	F	NR	Ischaemic stroke, specific symptoms NR	Previous TIA	NR	NR	NR	Medical management	Aspirin	No change	Aspirin 100 mg/day, atorvastatin 40 mg/day

			3	42	F	NR	Ischaemic stroke, specific symptoms NR	Chronic headache	NR	NR	NR	Medical management	Aspirin	No change	Aspirin 100 mg/day, atorvastatin 40 mg/day
			4	35	M	NR	Ischaemic stroke, specific symptoms NR	None	NR	NR	NR	Medical management	Aspirin	No change	Aspirin 100 mg/day, atorvastatin 80 mg/day
			5	41	M	NR	Ischaemic stroke, specific symptoms NR	Migraine	NR	NR	NR	Medical management	Aspirin	No change	Aspirin 100 mg/day, atorvastatin 40 mg/day
<b>Zhang et al (103)</b>	2023	Case report	1	69	F	NR	Paroxysmal left limb weakness for 2 days, then observed left central facial lingual palsy and left hemiplegia for 10 minutes on admission	Well-controlled hypertension and diabetes	NR	NR	NR	Medical management	Aspirin + atorvastatin	No change	NR
<b>Mutlu et al (104)</b>	2024	Case report	1	51	M	NR	Acute left-sided weakness in arm, facial palsy, dysarthria, transient and resolved after 15 minutes	NR	NR	NR	NR	Surgical	CEA		NR

**Appendix 1:** Summary of studies included

Abbreviations - **CAS** – Carotid Artery Stenting; **CaW** – Carotid Web; **CEA** – Carotid Artery Stenting; **DAPT** – Dual Antiplatelet Therapy; **DOAC** – Direct Oral Anticoagulant; **F** – Female; **IQR** – Interquartile range; **M** – Male; **NIHSS** – National Institutes of Health Stroke Scale; **NR** – Not Reported; **SAPT** – Single antiplatelet therapy; **SD** – Standard Deviation; **TIA** – Transient Ischaemic Attack